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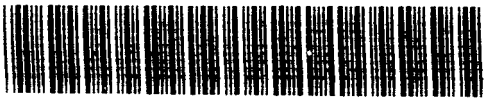
Manual of Naval Preventive Medicine

Chapter 4
SWIMMING POOLS AND BATHING PLACES



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Chapter 4

SWIMMING POOLS AND BATHING PLACES

Section 1. INTRODUCTION

4-1. Scope.

This chapter is provided for guidance of Medical Department personnel concerned with sanitary control, surveys, and inspections of all U.S. Navy and Marine Corps bathing and training facilities, both artifitial and natural, including over-the-side swimming. Other Department of the Navy personnel, both civilian and military, may use this publication as a guide for sanitary standards in the safe operation of training/swimming pools and other bathing facilities.

4-2. Responsibility.

1. The Naval Military Personnel Command is responsible for supervision, policy guidance, technical and administrative direction of the Navy-wide Recreational Services Program, which includes pool and inland/surf beach operations.

2. The Chief, Bureau of Medicine and Surgery (BUMED) is responsible for developing and promulgating health standards to protect the health and well-being of Navy and Marine Corps personnel.

3. The Naval Facilities Engineering Command is responsible for design, construction drawings and specifications, construction, major repairs, and maintenance standards for pools and bathing places.

4. The Commanding Officer is responsible for the operation of swimming and bathing facilities; however, this responsibility is normally delegated as follows:

a. The Recreation Director is assigned responsibility for management and operation of all recreational bathing facilities, both artificial and natural. This includes the proper selection and training of personnel.

b. The Medical Officer is responsible for vigilant surveillance of those aspects of operations, maintenance, and laboratory practice that pertain to health protection, and for making pertinent recommendations to the Commanding Officer.

c. The Public Works Officer is responsible for the maintenance and mechanical operation of all swimming pool facilities. Additionally, he/she is responsible for assuring that bacteriological and chemical analyses of pool water are performed by an acceptable water laboratory. The Department of Defense Construction Criteria Manual (DOD 4270.IM) and NAVFAC Design Manual DM-37.1 provide guidance.

4-3. Health Hazards in Swimming Pools and Bathing Facilities.

1. There is little epidemiological evidence that a well run pool will become a health hazard; however, water can and does transmit disease. Swimming in water polluted with sewage or infectious microorganisms from bathers can result in diseases of the skin, eyes, ears, nose, throat, or intestines. Bathing in natural waters contaminated with animal urine can result in leptospirosis, and contaminated snail infested waters can transmit schistosomiasis.

2. Types of Hazards.

a. Mechanical Hazards. These include slippery surfaces, projecting objects, floating or underwater obstructions, inadequate depth for div-

ing, sudden changes in depth, improper or illegible depth markings, insufficient lighting, and turbid water.

b. Electrical Hazards. Wiring, lights, and appliances are particularly dangerous near water.

c. Practices of Swimmers. Common practices that are violations of swimming safety include over-exertion, swimming with physical impairment or under medication which limits swimming ability, over-exposure to sun, wind, or water, swimming during thunderstorms, swimming too soon after eating, rough play, and swimming beyond limits.

d. Marine Hazards. Hazards which may be present in salt-water swimming areas are predatory fish, especially sharks; fish with dangerous mechanisms of defense, such as the Portuguese Man-of-War and the Sting Ray undertow, strong currents; sharp coral reefs, and discarded debris, i.e., cans and broken glass.

4-4. Definitions.

1. Air Gap. A physical separation sufficient to prevent backflow between the free-flowing discharge end of the potable water and any other system. An airgap is physically defined as a distance equal to twice the diameter of the supply side pipe but never less than one (1) inch.

2. Alkalinity. The amount of alkaline compounds (e.g. carbonate, bicarbonate) present in the pool water for the purpose of functioning as a buffer.

3. Alum. A fine, white, powdered aluminum sulfate compound, which when added to water, produces a flocculate of settleable particles which can be removed by filtration.

4. Anthracite (Anthrafilt). A hard, finely ground coal used as a swimming pool filter medium.

5. Appurtenances. Equipment components of the plumbing circulation system of a swimming pool.

6. Backsiphonage. Backflow resulting from negative pressure in the distribution pipes of a potable water supply.

7. Backwash. A procedure for cleaning swimming pool filters by reversing the flow of water through the filter which removes the trapped solid matter from the filter medium. When authorized the waste is discharged to the sewer drain.

8. Buffer. A chemical compound that resists changes in the acidity/alkalinity of the pool water by neutralizing acids and bases.

9. Chlorine Residual. The amount of chlorine remaining in the pool water after the chlorine demand (oxidation of organic compounds) is satisfied. The combined residual is the portion which reacted with nitrogen compounds (e.g. ammonia) to form chloramines. Free chlorine residual is the portion remaining available for rapid disinfection.

10. Cross-Connection. Any actual or potential connection between the public water supply and a source of contamination or pollution.

11. Cyanuric Acid. A compound added to pool water to reduce decomposition of chlorine residuals by the ultraviolet rays of sunlight.

12. Diatomaceous Earth. A white powder composed of the fossilized skeletons of one-celled diatoms and used as a filter medium in some swimming pools.

13. D.P.D. The chemical diethyl-p-phenylene diamine, in tablet form, is commonly used in a calorimeter type water test kit for the measurement of chlorine residuals.

14. Filtration. The process of removing suspended particles from the pool by circulating the water through a filtering medium.

15. Flocculent. A compound which when added to water causes suspended particulate to clump together and form larger particles that can be readily removed by filtration.

16. Flood-Level Rim. The edge of the receptacle from which water overflows.

17. Free Available Chlorine (FAC). The portion of the chlorine residual in water that is available for immediate oxidation (destruction) of bacteria and contaminants.

18. Hair Strainer. A device placed ahead of the pump to prevent hair, lint or paper debris from clogging the pump mechanism.

19. Muriatic Acid (Hydrochloric Acid). This chemical is used to reduce excess alkalinity in pool water.

20. pH. The relative degree of acidity or alkalinity of water as indicated by the hydrogen ion concentration. An acid-base scale is used; 7.0 is neutral, while O to 6.9 is acidic, and 7.1 to 14.0 is basic.

21. Precipitate. An insoluble compound formed by chemical action between two or more normally soluble compounds in solution (e.g., the addition of chlorine to a pool containing dis-

solved iron will cause a reddish precipitate of insoluble iron compounds).

22. Skimmer. A device other than a gutter that is an integral component of the recirculation system. The device continually removes floating debris and is designed to handle up to 80 percent of the recirculated pool water.

23. Slurry Feeder. A device designed to introduce or "feed" a slurry of chemicals (e.g., soda ash, alum) into the pool without clogging.

24. Soda Ash. Sodium carbonate ($Na\ CO_3$). A dry compound used to increase pH and total alkalinity in pool water. It neutralizes hydrochloric acid (HCL) produced from chlorination and results in an increase of the PH.

25. Sodium Bisulfate. A chemical ($NaHS0_4$) which produces a mild acid solution. Used in swimming pool water to lower the PH.

26. Superchlorination. The application of a high level of chlorine (5-10 ppm FAC) for the purpose of "burning off" or oxidizing accumulated organic matter and controlling algae.

27. Surge Tank. A tank used to collect overflow water from the pool, which can be used to add "make-up" water to the pool.

28. Turbidity. Degree to which suspended particles in pool water obscure visibility. Usually a cloudy or hazy appearance in pool water caused by finely divided particles suspended in water.

29. Turn Over. The number of times per day the water capacity of the pool is circulated through the filter.

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Section II. CONSTRUCTION, OPERATION AND INSPECTION OF SWIMMING/TRAINING POOLS AND BATHHOUSES

Article

4-5. Water Quality.

1. The first principle in sanitary control of swimming pools is to select water of the best quality. The water source for training and recreational swimming pools should be from a community water system. Wells or other sources of water" used solely for an individual pool must be approved by the local Medical Facility (Preventive Medicine Department).

4-6. Types of Swimming Pools.

1. Fill and draw pools, wherein pool water is exchanged by emptying and refilling, have no satisfactory method of water treatment. These pools are authorized for use in Navy and Marine Corps facilities only with specific approval from Naval Facilities Engineering Command (NAVFACENGCOM) and BUMED.

2. Flow-through pools exchange water by allowing source water to flow through the pool basin, but this pool has no satisfactory method of water treatment. Flow-through pools are not normally authorized and must not be used or constructed without specific written approval from BUMED and NAVFACENGCOM.

3. Recirculated pools have acceptable methods for disinfection of pool water. The same water is continuously filtered and disinfected to provide a safe water quality for swimmers. This is the only type of pool normally approved for construction. The principles involved in providing a healthful and sanitary pool are discussed in this chapter. General design and operating procedures for recirculating pools are presented.

4. Wading Pools and Splash Pads.

a. Wading Pools. A wading pool is an artificial pool with a maximum depth of 24 inches (61 centimeters (cm)) intended for use by children. The probability of infection from a wading pool is greater than from large pools. Young children are more likely than adults to contaminate and drink the waters. Wading pools are usually small, and should be constructed of the same material as the main pool. These pools should have a continuous inflow of treated water to give a complete water change every hour. Overflow should be of the open type, extend completely around the pool and should be returned to the filtration system of the main pool. Water supply and recirculation must be a part of the main pool's circulation and filter system. Careful consideration must be given to assure adequate distribution of the treated water and provide the necessary recirculation. It is generally recommended that wading pools be converted to splash pads which are easier to operate in a sanitary manner.

b. Splash Pads. These are artificial pools for use by children. Treated water is sprayed into the pool and runs to waste or is returned to the main pool filtration system. Slash pads serve the same purpose as wading pools, but eliminate many of the hazards since the water is not contained in a pool.

4-7. Pool Location.

Swimming pools should be located to prevent storm and other surface drainage from entering the pool. The deck should be well above the ground level and located at a site where dirt, dust and debris will not be carried or blown into the pool. Trees and shrubbery may enhance the appearance of a pool, but they should be located so that leaves and other organic material do not fall into the water. The pool area should be enclosed by a fence or wall no less than 7 feet (2.1 m) high and preferably 8 feet (2.4 m) high. The gate(s) shall be locked closed when the pool is not in use. The bathhouse should be located to provide a windbreak from prevailing winds. Some pools located near living quarters, where dressing, shower, and toilet facilities are available, are not required to have a bathhouse. In these instances, the pool should be provided with outdoor showers, where swimmers will be required to shower before entering the pool area. All new or renovated pools should be provided with bathhouses. If a spectator area is provided, it should be separate and distinct from the bath area with separate entrances.

4-8 Construction and Design.

1. Materials. Swimming pools and appurtenances should be constructed of materials which are inert, nontoxic, impervious, permanent, and can withstand design stresses. NAVFACENGCOM recommends concrete, metal, or combinations of concrete and metal for tank construction. Concrete may be either poured or pneumatically applied, depending on relative cost, type of soil, and availability of specialized tools equipment, and skilled labor. Concrete provides a smooth surface to which an easily cleaned surface can be applied. Pools should be finished in white or light colors (e.g., light blue, blue-green, or turquoise), and should be smooth. Expansion joints are required, and construction joints may be necessary. Earth or sand bottoms are not permitted.

2. Size and Depth.

a. All pools must be designed and constructed to withstand anticipated loads for both full and empty conditions, and a pressure relief valve must be provided to relieve pressure caused by hydrostatic head when the pool is empty. Swimming pools must be designed to make supervision of swimmers easy.

b. The minimum water depth in the shallow end of the pool should be 3 feet (90 cm) deep, except in special purpose competitive or training pools. Areas less than 3 feet (90 cm) should be separate from the main pool and considered as wading pools.

3. Bottom and Sidewalls.

a. Where water depth is less than 5.5 feet (1.7 meters (m)), the pool bottom slope must be a maximum of 1 inch per foot (2.5 cm per 30 cm). Sudden slope changes or flat areas are prohibited. In pools less than 50 feet (15 m) overall length, the rate of the slope maybe increased to 1.5 inches per foot (3.8 cm per 30 cm).

b. Where water depth is greater than 6 feet (1.8 m) the slope should not exceed 1 foot in 3 feet (30 cm in 90 cm).

c. If safety ledges are provided on vertical walls in deep portions of the pool they should not

be over 4 to 6 inches (10 to 15 cm) wide and be at least 4 feet (1.2 m) below the water surface with a slope 0.5 inch in 4 inches (1.3 cm to 10 cm) "toward the pool.

4. Ladders and Handrails. Ladders should be provided at the shallow end of the pool and on each side at the deep end of the pool. Normally a mode of egress is provided for each 75 feet (23 m) of pool perimeter but there should be at least three. They must be constructed of nonferrous metal, with handrails on both sides; treads must have nonslip top surfaces. Ladders should have a clearance of not more than 6 inches (15 cm) nor less than 3 inches (8 cm) between the ladder and the pool wall. Recessed stepholes or stairways built out from the wall are prohibited. Handrails should be provided for all steps and ladders leading to diving boards more than 3.3. feet (1 m) above the water. Diving platforms over 3.3 feet (1 m) high should be protected with guardrails.

5. Deck and Adjacent Area. The deck areas of indoor pools must completely surround the pool, and be 12 feet (3.6 m) wide, except 15 feet (4.5 m) is required at the diving board end only. The minimum deck width for outdoor pools is 15 feet (4.5 m) with 20 feet (6.0 m) at the diving board end only. Deck areas must have a slope of 1/8 inch per foot (0.3 cm per 30 cm) away from the pool edge. Deck drains should be located so that one deck drain will serve a maximum of 250 square feet (23.2 square meters) of deck area. The deck will be smooth, with a nonslip surface, and easy to maintain. A curbing of nonslip material should be provided around the perimeter of a pool. Outdoor pools must be provided with a curb on the outside of the deck area to prevent litter or dirt from reaching the deck area and the pool.

6. Markings.

a. All variations in pool depth of 1 foot (30 cm) will be marked on the pools deck. In the case of indoor pool, markings may also be located on the adjacent walls. For outdoor pools, depth marking may also be mounted on the perimeter fence at the edge of the deck.

b. Swimming lane markings, of the same finish as the pool lining, should be provided on the bottom of the pool.

c. Either the main drain should be clearly marked by laying colored tile around the drain perimeter, or the grating should be painted a conspicuous color.

7. Diving Boards and Area.

a. Standard diving "spring" boards are 14 to 16 feet (4.3 to 4.9 m) long and 1.67 feet (50.9 cm) wide. The standard distance for mounting the board is 3.3 feet (1 m) or 9.8 feet (3 m) above the water. They should be of aluminum or fiberglass construction with a nonslip surface. Diving boards should be well anchored to the deck and should be installed with a lockable fulcrum adjustable over a distance of 10 to 12 inches (25 to 31 cm). The front end of the board must be at least 5 feet (1.5 m) beyond the pool wall for 14 foot (4.3 m) boards, and 6 feet (1.8 m) for 16 foot (4.9 m) boards.

b. Indoor pools must be provided with at least 16 feet (5 m) of headroom above the highest diving board.

c. The distance from the center line of diving boards to the pool side walls should be at least 12 feet (3.7 m).

d. The minimum distance between diving boards, measured from the center lines, should be 12 feet (3.7 m) or 10 feet (3.1 m) clearance between diving boards.

e. The water depth adjacent to diving boards must conform to the following safety standards:

Table 4-1. Water Depth Standards for Diving Board Safety

Elevation of diving board above water	Minimum depth of water under end of board	Minimum length of the diving well
1.6 feet (0.5 m)	9 feet(2.7 m)	25 feet(7.6 m)
3.3 feet (1.0 m)	10 feet(3.1 m)	35 feet (10.7 m)
9.8 feet (3.0 m)	12 feet 3.7 m)	40 feet (12.2 m)

8. Chlorine Gas Room. Cylinders containing chlorine gas shall be enclosed in a room to protect the pool operators, swimmers, and spectators from accidental leakage of chlorine gas. The room shall be above ground, in all new construction, and separated by tight fitting partitions. Natural ventilation (louvered doors and/or walls) or a sparkproof ventilation system capable of producing a complete exchange of air in 2 minutes should be provided. The system must exhaust from the floor level. The control switch

for the exhaust fan should operate automatically when the door is open; however, if the switch is manually operated, it shall be located outside of the room. Provisions must be made in the room for adequately securing tanks (e.g., chaining to wall or post), An automatic chlorine detection unit should be provided and a suitable warning sign should be posted. The exit door must open to the outside, and there should be at least one observation window for viewing the interior from the outside. The floor should have a nonslip finish. A potable water outlet must be provided in the immediate area. An emergency potable water eyewash/shower system, American National Standards Institute (ANSI) approved, must be located in the immediate area.

a. Signs will be posted at all swimming pools instructing personnel to:

(1) "IMMEDIATELY EVACUATE" the area and move upwind from the leak;

(2) Do not enter the chloride room or try to stop the leak.

b. Fire department and other emergency telephone numbers will be posted and notified immediately in case of a chlorine gas incident.

c. Lifeguards and other supervisory personnel will receive indoctrination in the proper procedures to follows in case of a chlorine gas incident. The procedures will be provided in a Standard Operating Procedures (SOP) Manual.

d. Only properly equipped emergency personnel with pressure demand self contained breathing apparatus (SCBA'S) will attempt to stop a leak.

e. Most chlorine gas leaks can be easily repaired; however, some leaks may require the use of special clamps to seal them. Facilities in which chlorine gas cylinders are used must ensure that the fire department is properly equipped to handle incidents of this nature.

9. Bathhouse. DOD Manual (4270.1-M) provides criteria for bathhouse construction. The bathhouse should provide entrance to the pool near the shallow end, and should consist of dressing rooms, clothing storage facilities, toilets, and showers. Bathhouses used by both sexes should be separated by tight partitions with privacy screens placed at the entrances. Floors should be made of smooth, nonslip and impervious material with the corners and intersections between the floors and walls rounded. All floors must have a pitch of ¼ inch/foot (0.6 cm/30 cm) and slope to drain to permit cleaning with a hose. Floors should be cleaned daily and disinfected with an approved disinfectant (e.g., 50 ppm chlorine solution). The facility should be provided with natural and/or mechanical ventilation to reduce excessive heat and dampness. Fluorescent lighting designed to provide a minimum of 20 foot candles must be provided.

a. Dressing Rooms. Walls and partitions should be of smooth impervious masonry, construction with no open cracks or open joints. Partitions between dressing compartments should terminate 6 inches (15 cm) above the floor. Lockers, when provided, should be well ventilated, set on a closed base furnished with the locker unit, substantially anchored to the floor, and braced at the top. The lockers should be vermin proof and tightly jointed. Furniture should be simple and easily cleanable.

b. Plumbing Fixtures. Hot-water showers not to exceed 100°F (43.34°C) with soap dispensers must be provided. A central automatic mixing valve is recommended. Drinking fountains will be the angle-jet type. Multiple hose bib connections with back flow prevention devices should be provided for ease in cleaning. Lavatories with liquid soap and paper towels or hand drying devices will be provided. Toilet and lavatory facilities should be inspected by the pool operators every 2 hours and should be cleaned at least once a day. Separate plumbing fixtures for swimmers and spectators may be provided, as listed below in Table 4-2.

c. Waste Disposal.

(1) Waste Water. Liquid waste from the bathhouse or related facilities will be discharged to the base or municipal sewage system.

(2) An adequate number of solid waste receptacles with self-closing lids must be located in the bathhouse (e.g., toilet and dressing rooms) and spectator areas. The receptacles will be emptied and cleaned at least daily or as necessary.

Table 4-2. Swimming Pools: Sanitary Facilities Required Based Upon User Load

Facility	Number of Swimmers		Number of Spectators	
	MALES	FEMALES	MALES	FEMALES
WaterCloset	1/40	1/20	1/250	1/150
Lavatory	1/40	1/40	1/200	1/150
Urinal	1/40	-	1/250	-
Shower	1/30	1/30	-	-
DrinkingFountain	1/100	1/100	1/400	1/400

4-9. Recirculation System and Appurtenances.

1. Outlets. Water is removed from a swimming pool for treatment and recirculated through overflow gutters or skimmers and main drains. Gutters and skimmers remove oils and other floating wastes.

a. Overflow gutters generally extend completely around the pool, and are capable of handling 50 percent of the recirculating water. The openings into the gutter usually are less than 4 inches (10 cm) wide with the interior approximately 3 inches (7.6 cm) wide and 3 inches (7.6 cm) deep. The outlet pipes inside the gutter should be at least 2.5 inches (6.4 cm) in diameter and the cover grate should be 1.5 times the size of the outlet pipe:

b. Skimmers should be provided at the ratio of 1 *skimmer for* each 500 square feet (47 square meters) of pool surface, or fraction thereof. They should be located to insure proper skimming of the pool surface. The rate of flow through the skimming device(s) must be adjustable up to a minimum of 80 percent of the capacity of the swimming pool filter system. Each skimmer should have a flow of at least 30 gallons per minute (114 liters per minute); the skimmer intakes should be designed to adjust automatically with variations in the water level over *a* range of at least 3 to 4 inches (7.6 to 10 cm). Skimmers are provided with *a* removable screen or basket which the recirculating water must pass through and a device to prevent airlock in the suction line, normally a surge tank or an equalizer pipe.

c. Main Drain(s). The main drain should be capable of completely draining the pool in 4 hours. Pools with deep ends should have one or two outlet drains located at the deepest point. The location of drains depends on the-size of the pool. Generally, drains should not be located more than 20 feet (6 m) apart nor more than 10 feet (3 m) from a sidewall. Either the main drain should be clearly marked by laying colored tile around the drain perimeter or the grating should be painted a conspicuous color. The main drain outlets shall be covered by a grating at least four times the size of the discharge pipe. The openings in the grating should be no larger than 0.5 inch (1.3 cm) to avoid catching hands and feet. The maximum discharge of water through any drain outlet should not exceed 1.5 feet per second (50 cm per second). It is important the main drains not be located near the diving trajectory area to preclude the possibility of divers landing on the grate if they touch bottom. The main drain(s) should be designed with a capacity to recirculate at least 50 percent of the recirculating water, thereby, improving circulation in all areas of the pool. The drain must not have a direct connection to the sewer, but must be provided with an air gap to prevent the possibility of back flow.

2. Surge Tank. This tank is located on the suction side of the recirculating pump and serves as a means of maintaining a constant level of water in a pool. A potable water connection, with a flow-controller valve, admits fresh water whenever pool water is lost through evaporation and splash. It can also be used as a site to introduce chemicals in an emergency. The fresh water inlet must be protected from backsiphonage by an air gap or backflow prevention device.

3. Chlorinator-Hypochlorinator. These devices are designed to introduce chlorine into a swimming pool recirculating system. A chlorinator in-

jects chlorine gas and a hypochlorinator introduces a liquid containing chlorine. It is recommended that chlorine be introduced into recirculation on the suction side of a vacuum type diatomaceous earth filter or the newer high-rate sand filters. Automatic chlorinators maintain the chlorine residual at a predetermined level by controlling a solenoid valve on the chlorine injector adjusting the chlorine gas flow, as required. Automatic chlorinators are recommended as standard equipment for Navy and Marine Corps training and swimming pools. Gas chlorinators should have as a standard accessory a siphon breaker (vacuum breaker) installed between the injector and the point of application, when the chlorinator and the auxiliary equipment are located higher than the surface of the pool water. This breaker is necessary in the event of recirculating pump failure or shut-down since the water in the recirculation system tends to drain into the pool causing a negative head. If the chlorinator is automatically activated by the recirculating pump, it may continue to operate and fill the empty recirculation system with chlorine gas. When the recirculating pump is restarted, the undissolved chlorine gas could be discharged into the pool and result injury to swimmers.

4. Chemical Feeders.

s. An adjustable chemical feeder to inject soda ash should be provided prior to the filters on the suction side of the recirculation system.

b. Pools using conventional rapid-flow pressure sand filters (designed to operate with a flocculent) are equipped with an alum solution feeder located on the suction side of the recirculation pump.

c. If diatomaceous earth filters are used, they will have slurry feed equipment to continuously apply diatomaceous earth to the recirculating water during a filter run.

5. Vacuum Cleaners.

a. The standard vacuum cleaner is permanently installed with suction hose fittings built into the wall of the pool and the piping connected to the suction side of the recirculation pumps. The connections for the vacuum cleaning hose are submerged and located so all pools surfaces may be reached with the cleaning tools. The cleaning water is recirculated.

b. Occasionally, non-standard vacuum units may be found, especially in older pool installations. These may consist of a pump mounted on wheels that may be pushed around the pool edge. The base and vacuum head are attached to pump with the discharge side usually attached to a waste drain which results in a considerable water loss each time the pool is cleaned. Another type, of recent design, is a self-propelled vacuum cleaner which rolls unattended along the bottom of a pool until its sensors strike the pool wall, then it turns and rolls in a new direction. This vacuum unit pumps water and dirt through a fabric bag which retains the debris with no resulting water loss. This vacuum type may be used as an auxiliary unit. The standard vacuum system should always be provided with new construction, modifications, or renovation.

6. Interceptors (Hair Strainers). Hair and lint strainers are located on the suction side of the recirculation pumps and prior to a vacuum-type diatomaceous earth filter. Strainers should be made of corrosion resistant metal with openings not more than 1/8 inch (0.3 cm) in diameter. The straining surface should be at least 10 times the size of the inlet area. Pools intended for training must be provided with interceptors.

7. Recirculating Pumps. Pumps will be capable of passing a minimum of 3 (preferably 4) times the pool volume through recirculation in 24 hours. In addition, they must have sufficient capacity and pressure to backwash the filters.. Training pools should have 2 pumps.

8. Filters.

a. Sand Filters. Convention rapid-flow pressure filters and high-rate sand filters are used for Navy and Marine Corps pool installations (see Figure 4-l).

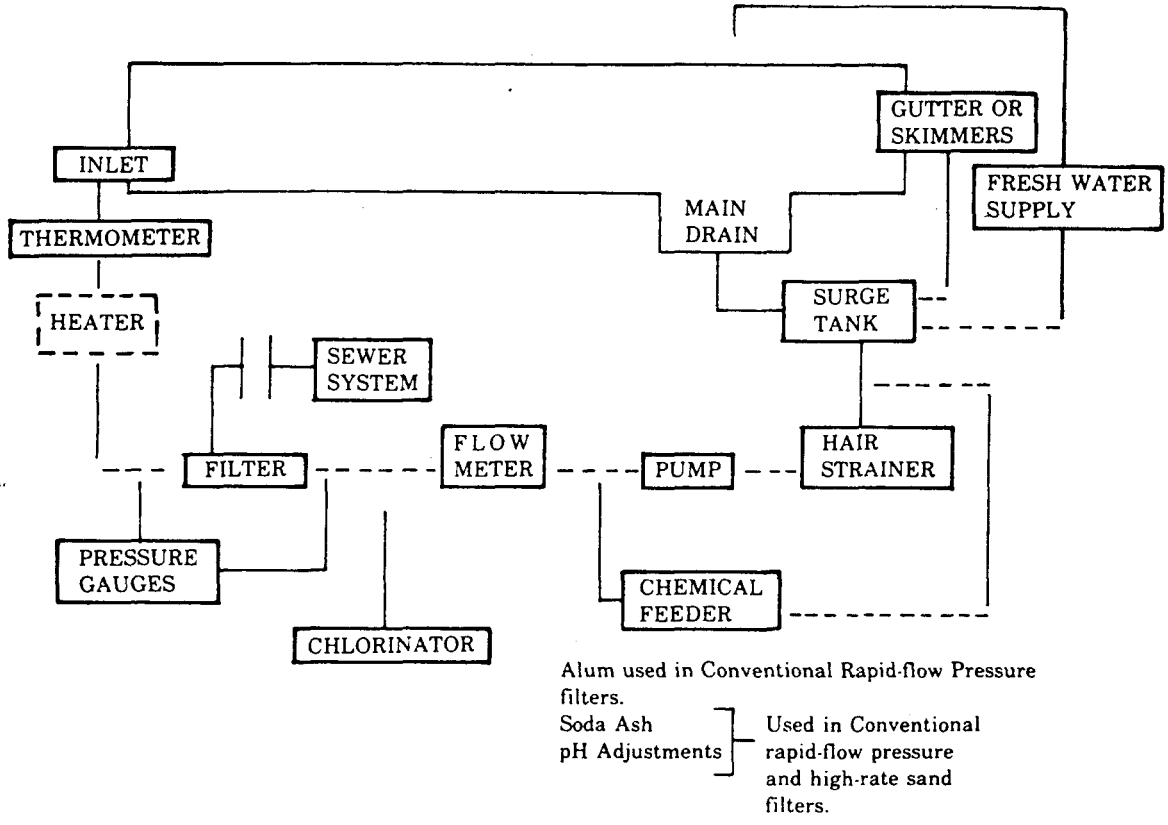

Figure 4-1. Sand Filter Diagram

(1) Conventional, rapid-flow pressure filters were standard for many years and are still in use. Anthracite (crushed coal) filters are similar in design and operation; therefore, the following is applicable. The filters are designed to operate with a flocculent (aluminum sulfate is recommended) injected into the recirculating water on the suction side of the filters. The operating flow rate is not more than 3 gallons per minute (11 liters per minute) for each square foot of filter surface. The surface area must be sufficient to recirculate the total volume of the pool 3 or 4 times each day. A bank of 2 to 5 tanks, depending on size, is normally required for standard sized pools. The tanks contain a media that consists of 4 layers of material (coal or sand and gravel). The layers vary from coarse at the bottom to very fine at the top. There should he 6 to 10 inches (15 to 25 cm) of space between the surface of the filter and the baffle on the inlet pipe to prevent the full stream of water from directly striking the sand. Each tank must have an air relief valve at the highest point and at least one access manhole for inspecting, removing or replacing the media. Recirculating water flows from top to bottom and can be reversed by opening and closing valves. Backwashing (cleaning) requires a reverse flow of 12 to 15 gallons per minute (45 to 57 liters per minute) for each square foot of filter area for sand and 8 gallons per minute (30 liters per minute) for anthracite. Backwashing should commence with 6 to 8 pounds loss of head and continue until the effluent runs clear, usually about 15 minutes. Water from backwashing is discharged to waste.

(2) High-rate sand filters operate on a different principle, instead of using only the surface of the sand with a flocculent, approximately the top 10 inches (25 cm) of sand collects suspended matter before backwashing is necessary. No flocculent is used with high-rate sand filters. The operating flow rate is approximately 20 gallons per

minute (76 liters per minute) per square foot of filter area. Usually one tank provides sufficient filter surface for one pool. The filter medium is either coal or sand of fine uniform size. An air relief valve is located at the top of the tank. Backwashing is indicated by a 15 to 20 pound loss of head. The backwash flow rate is 15 to 20 gallons per minute (57 to 76 liters per minute) per square foot of surface area. Backwash time is rapid; only 2 to 4 minutes are required.

b. Diatomaceous Earth Filters. Water is filtered by passing it through a thin coating of diatomaceous earth that is impinged on a filter septum (or leaf). These filter septa have very small (about 0.005 inch) openings. The water is forced through the filter by either positive or negative pressure (vacuum) (see Figure 4-2). NAVFAC-ENGCOM requires slurry feed equipment to apply the diatomaceous earth continuously during a filter run. The flow rate is 2 gallons per minute (7.6 liters per minute) per square foot of filter element. Space requirements are about the same as high rate sand filters. Diatomaceous earth filters require more attention than sand fillters. Backwashing, depending on the manufacturer, is accomplished by reversing the flow, by air pressure or by hand rinsing with a hose. When backwashes, the used diatomaceous earth must be disposed of in a manner satisfactory to local regulatory agencies.

9. Gauge.

a. A pressure gauge is installed on the inlet and outlet lines of each pressure filter to determine loss of head and backwash intervals.

b. A gauge to indicate rate of flow must be installed in the return piping after the filtration system. It should be capable of measuring 1.5 times the design flow rate and must be accurate within 10 percent of the true flow rate.

10. Temperature.

a. Heating System. Heating units are usually located in the recirculation system. Heaters must not be installed in the pool. The introduction of live steam into the pool is prohibited.

b. Water Temperature. The water temperature in swimming pools should be maintained between 65°F-82°F (18.3°C-27.8°C).

(1) Outdoor pools feel warmer than indoor pools of the same temperature. Bathers accept water temperatures of 65°F-78°F (18.3°C-25.6°C) in outdoor pools more readily than in indoor pools. See NAVFAC DM-37.1 for guidance on outdoor pool heating.

(2) Water temperatures of indoor pools should vary according to the use or purpose of the pool. Pools used exclusively for competition should be held between 76°F to 78°F (24.4°C-25.6°C). Pools used exclusively for recreational purposes should be held between 78°-82°F (25.6 °C–27.8ºC). A compromise in water temperature may be necessary between competitive and recreational needs for multi-use pools.

c. Air Temperature. In winter, the air temperature in indoor pool facilities should be kept approximately 3°F higher than the pool water temperature, while in summer, 8°F above is satisfactory. Bather comfort is affected by air temperature, air movement, and humidity. Bathers feel chilled when there is rapid air movement and low humidity, and if the air temperature is quite high, e.g., 90°F (32°C). Under these conditions, the rapid evaporation of water from the skin will make a bather feel cold. Humidity in the 75 to 85 percent range is effective for bather comfort and for reducing serious problems with equipment due to condensation.

11. Pool Water Inlets. Inlets from the filters must be located to produce uniform circulation of water through the entire pool. To reduce the escape of chlorine, the inlets shall be submerged a maximum of 1 foot (30.5 cm) below the pool water line.

4-10. Equipment Standards.

1. Swimming pool equipment for new construction of pools at Navy and Marine Corps facilities should bear the seal of the National Sanitation Foundation (Standard #50) or be equivalent. The following equipment is listed in Standard #50:

a. Diatomaceous Earth type filters.

b. Sand type filters.

c. Recessed automatic surface skimmers.

d. Centrifugal pumps.

e. Adjustable output rate chemical feeding equipment.

f. Multiport valves.

g. Cartridge and high permeability type filters.

h. Flow through chemical feeding equipment.

2. Disinfection.

a. Chemical disinfection is an integral part of pool water treatment.

b. Chlorine is the only disinfectant approved for use in training and bathing facilities. The strong disinfecting and oxidizing properties of chlorine aid in making water bacteriologically safe, free from algae and organic matter, and aesthetically acceptable to the bather.

c. The use of other disinfectants (e.g., iodine, bromine) is prohibited without prior written approval from NAVFACENGCOM and BUMED.

d. Chlorination. Chlorine is usually introduced in the pool water as a gas (99.9 percent available chlorine), as calcium hypochlorite (65 to 75 percent available chlorine), and occasionally as sodium hypochlorite.

e. Chlorine gas. Chlorine in the gaseous state is extremely toxic and heavier than air. Strict adherence to safety regulations is required. Chlorine gas rapidly lowers the pH of the pool water. Soda ash is necessary to maintain a properly balanced pH.

f. Calcium Hypochlorite is 65 to 75 percent available chlorine bonded to a granulated calcium. The chlorine in calcium hypochlorite is released from the granulated calcium bond by just dissolving it in water. The liquid supernate is then transferred to a hypochlorinator which automatically adds the chlorine solution to the pool water. There will be a slight rise in pH.

g. Sodium Hypochlorite is a slightly yellowish liquid in concentration of 12-15 percent available chlorine. The liquid can be added to the pool by a hypochlorinator. The pH will rise slightly with use of the liquid. Sodium hypochlorite is not normally used because of excessive cost and quantity required.

4-11. **Water Treatment.**

1. Clarity. Pool water must be free of suspended matter and sufficiently clear to see, from the pool sides, a four inch (10.2 cm) diameter black on white disk at the floor level of the deepest end of the pool. The main drain(s) should be visible at all times.

2. Chemical Balance. Maintaining a pool in a sanitary and aesthetically pleasing condition requires the operator(s) to have a thorough working knowledge and understanding of pool water chemistry. The desired water quality can be achieved and maintained with filtration and properly balanced chemical additives.

a. Aluminum Sulfate (Alum).

(1) Conventional rapid flow pressure filtration systems are designed to use the process of flocculation to enhance the filtering efficiency.

(2) Alum is injected into the recirculation system causing suspended particles to clump together. The flocculated matter produces a thin, jellylike mass on the top layer of filtering medium.

(3) The alum is introduced into the water by a chemical feeder located on the suction side of the recirculation pumps.

(4) The alum solution should be made with granulated plain aluminum sulfate. ‘

(5) When alum is used, the alkalinity level should be maintained at 80-120 ppm to permit the alum to function properly and to prevent drastic fluctuations in pH and alkalinity.

b. Chlorine Disinfection.

(1) When gas chlorine is introduced into pool water, the resulting chemical reaction forms two compounds of interest: hydrochloric acid (HCL) and hypochlorous acid (HOC L). In chlorination, hydrochloric acid is not considered a useful compound. This compound lowers the pH of water. When sodium or calcium hypochlorites are used as the source of chlorine, the resulting sodium and calcium hydroxides serve no useful purpose and raise the pH of the water. Soda ash is introduced to neutralize the lowering of the pH by gas chlorination. Sodium bisulfate is introduced to neutralize the rise in pH by sodium and calcium hypochlorites. Hypochlorous acid (HOCL), formed from all sources of chlorine, is an effective oxidizing agent and bactericide and is referred to as “free available chlorine (FAC).”

(2) Free Available Chlorine (hypochlorous acid (HOCL)). This compound exists in the molecular (HOCL) or ionized state (OCL-). The pH of the pool water determines the amount in each state. Hypochlorous acid in the molecular state (HOCL) is approximately 300 times more effective as a bactericide than in the ionized state (OCL-). Table 4-3 indicates the effect of pH on hypochlorous acid (free available chlorine) at 68°F(20°C).Therefore, as the pH of the pool water increases, the effectiveness of the chlorine residual decreases (see Figure 42).

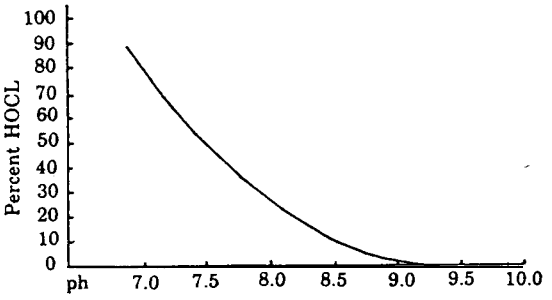

Figure 4-2. Percent of Ionization of HOCL as pH of Water Varies

(3) Free available chlorine is an excellent oxidizing agent that will oxidize organic matter and many inorganic compounds. If the amount of hypochlorous acid (free available chloring) being added to the pool is insufficient to oxidize all the nitrogen (ammonia) compounds present, then chloramines will be formed. Nitrogen (ammonia) compounds are always available in the pool, from bathers (e.g., perspiration) to form chloramines. The formation of chloramines is referred to as combined chlorine residual. Combined chlorine (chloramines) is not as effective in disinfection as free available chlorine. Chloramines produce eye irritation and the objectionable "chlorine" odor associated with pools.

(4) Breakpoint Chlorination. When free available chlorine is added to water containing ammonia compounds, it reacts with the ammonia to form chloramines. When the total chlorine residual (free available plus combined chlorine residual) increases until the concentration reaches a point that forces the ammonia compounds to be burned off (oxidized), a sudden drop in the residual, called breakpoint chlorination, occurs. At breakpoint, most of the combined residual disappears along with eye irritation and the objectionable "chlorine" odor. The remaining chlorine in the water is mainly in the free available state. Breakpoint chlorination will occur at different concentrations in different waters.

Table 4-3. Percentage of Hypochlorous Acid in Solution Depending of pH of Pool Water at 68°F (20°C)

pH of Pool Water	Hypochlorous Acid in Molecular Form (HOCL)
6.0	96.8%
7.0	75.2%
8.0	23.2%
9.0	2.9%

(5) Cyanurates (Stabilized Chlorine). Cyanuric acid is used in outdoor pools to "stabilize" the chlorine from rapid destruction by ultra-violet light from the sun. Cyanuric acid can be added to any pool water using chlorine (gas or hypochlorites). Chlorinated cyanurates are commercially available as a single chemical containing a combination chlorine and cyanuric acid. Regardless of the source or concentration, the effect of cyanuric acid in pool water is the same. Cyanuric acid has no chlorine demand and does not affect the breakpoint chlorination phenomenon. Cyanuric acid has little or no affect on the bactericidal properties of chlorine at the concentrations and pH recommended for pool water. Cyanuric acid residuals can be reduced by dilution with cyanuric acid free water. Cyanuric acid concentrations in excess of 100 ppm are not recommended. Handle and store the chemical as recommended by the manufacturer. Minimum free available chlorine (FAC) concentrations depending on the pH of the pool water are shown in Table 44. These are minimum allowable concentrations, but some pool operators may maintain the FAC at 1.0 ppm or higher, even without cyanuric acid stabilization, to improve the clarity and appearance of the pool.

c. pH

(1) General. pH is the logarithm of the reciprocal of the hydrogen ion concentration of water. Pure (distilled) water (H_2O or HOH) is a compound which will ionize to form an equal amount of hydrogen ions (H+) and hydroxyl ions (OH–). An acid is a compound which ionizes to produce an excess of hydrogen ions. A base is a compound which ionizes to produce an excess of hydroxyl ions. pH has a value range of 0 - 14, 0 is very acidic, 7 is neutral and 14 is very alkaline. The pH of a solution does not indicate how much acid or base is present, but indicates the degree of ionization. This point is very important when alkalinity is discussed.

(2) Range. The pH range for pools must be maintained between 7.2 to 8.0. Accurate pH control is essential. Corrosion to pipes, filters and pumps will result in a short time when the pH is

below 7.0. High pH values will reduce the effectiveness of the disinfectant and encourage the growth of algae. Eye irritation will occur if the pH value is below 7.2 or above 8.0.

(3) Control. The addition of soda ash (alkaline compound) will raise the pH of water. The addition of sodium bisulfate (acid compound) lowers the pH of water. Correction of other chemical imbalances (alkalinity and hardness) will often return the pH to normal.

(4) Comfort. Water is less irritating to the bather at a pH of 7.6 to 8.0; however, chlorine is more effective as a bactericide at 7-2 to 7.6.

d. Alkalinity.

(1) General. Alkalinity is a measure of the ability of a solution to neutralize hydrogen ions (H+) or act as a buffer. Alkalinity exists in pools in three forms: bicarbonate (HCO_3-), carbonate ($C0_3$-^{2}), and hydroxide (OH-). The form is dependent on the pH of the water. Hydroxide alkalinity is irritating to the eyes and cannot occur if the pH is much below 9.0. Carbonate alkalinity is also irritating to the eyes and occurs in a pH range of approximately 8.0 to 10.0. Bicarbonate alkalinity is the least irritating to the eyes and exists in a pH range of approximately 5.0 to 9.0, If a pool has a proper pH balance, the predominant form of alkalinity present would be in the bicarbonate form.

(2) Range. Alkalinity assists in maintaining stable pool pH. The values should be between 80-120 ppm for proper alkalinity of the pool. If the alkalinity is less than 50 ppm, the pH can change rapidly due to bather load, temperature, addition of chlorine, or pH adjustment. When the alkalinity is too high, usually greater than 200 ppm, the pH adjustment is difficult.

(3) Adjustment of Alkalinity. Sodium bicarbonate can be used to raise the alkalinity level with little effect on pH. The resulting alkalinity (80-120 ppm) serves as a buffer to ensure a stable pool pH.

(4) Effect on Filters. Proper alkalinity balance is necessary in pools using alum floe on conventional sand filters, because the alum must react with alkalinity to produce the floe. If the alkalinity is too low, the alum will pass through the filters in the dissolved form creating a floe in the pool when the alkalinity is adjusted.

e. Hardness.

(1) General. Hardness is a measure of the mineral content of water. Calcium, magnesium, and iron are the major mineral compounds that cause problems in pools. These compounds interfere with pool clarity and bather comfort.

Table 4-4. Minimum Free Available Chlorine (FAC) Concentrations Depending on pH of Pool Water

pH	FAC in mg/L not stabilized with cyanuric acid	FAC in mg/L cyanuric acid concentration of 30-100 mg/L
7.2	0.4	1.00
7.3	0.4	1.00
7.4	0.4	1.00
7.5	0.4	1.00
7.6	0.5	1.25
7.7	0.6	1.50
7.8	0.7	1.75
7.9	0.8	2.00
8.0	1.0	2.50

Key:mg/L=milligrams per liter

(a) Calcium and magnesium compounds cause encrustation of pipes, especially water heaters and fittings. Filter encrustation will occur largely from calcium compounds.

(b) Iron compounds will impart a green color to the pool water. A reddish brown precipitate will also occur which can discolor pool walls, floors and clog filters.

(2) Treatment.

(a) Calcium and Magnesium. Encrustation of pipes, heaters, and fittings from calcium or magnesium can be removed by treatment with an acid (e.g., muriatic acid). Only enough must be used to react with the minerals to prevent damage to the pipes and equipment. The use of soda ash will continually precipitate out the calcium compounds.

(b) Treatment of iron-bearing water with high chlorine residuals will oxidize the iron compounds. The resulting precipitate (a red-brown ferric oxide) can then be filtered out. Usually, the appearance of iron compounds in the pool is a result of the pH dropping to 7.0 or below in pools with iron pipes and equipment.

f. Algae Control. A major concern in swimming pool maintenance is the prevention of algae growth. Although algae are harmless from a communicable disease standpoint, they contribute to making walls, pool floors and walkways slippery and creating safety hazards. Pool con-

ditions which promote algae blooms may also permit the survival of harmful bacteria. Chlorine, if present under these conditions, will probably be in the combined form (chloramine), which will cause eye irritation.

(1) The best control measure for algae is to prevent its growth. This, in almost all cases, can be accomplished with proper FAC residual.

(2) Swimming pools, especially outdoor pools, should be superchlorinated weekly to control algae growth.

(3) If algae blooms become established in a pool, the removal becomes more difficult.Super chlorination followed by pool brushing and vacuuming may suffice. If large blooms have become established, it will probably be necessary to drain the pool and scrub all surfaces with a 200 ppm FAC solution. This solution can be made by adding one ounce (30 milliliters) of household bleach to 2 gallons (7.6 liters) of water.

(4) The use of commercial algicides or algistatics are not generally recommended, because frequently the active ingredient is simply chlorine. Algicides containing mercury, once widely used, are prohibited in the United States. In those rare instances when algae have demonstrated a resistance to chlorine, algicides with copper sulfate may be used. The pool should be drained of water and the sides scrubbed with a solution containing 5 percent copper sulfate by weight. The solution may then be flushed to waste.

4-12. Safety and Swimming Pool Regulations.

1. Death and injury related to swimming pool accidents increase each year as more and more people take to the water. The key ingredients to preventing such accidents are proper pool design, maintenance, supervision and a "clear cut" set of regulations designed with the bathers' overall safety in mind. The following guidelines must be practiced at each facility.

a. Safety Lines. The diving well or deep end will be divided from the rest of the pool by use of an appropriate buoy line tightly fastened at each side of the pool. The safety line should be located 1-2 feet (30-60 cm) from the breakpoint over the shallow portion of the pool.

b. Diving Boards. All diving boards, above 3.3 feet (1 m), must have steps and hand rails. Except during diving competition or exhibitions, the fulcrum should be permanently locked and/or relocated to the forward most position which reduces overall board spring.

c. Lifeguard Stations.

(1) One guard is required for up to 50 bathers and an additional guard for each designated diving area. If a pool has two separate diving areas, an additional guard will be required in each separate diving area.

(2) In small pools (less than 2,000 square feet of water surface area), one guard may be adequate to safely guard the diving and swimming areas if the combined zones represent one overall pool facility.

(3) In large pools (over 10,000 square feet of water surface area), the job of supervision becomes more difficult. Generally, this size pool contains areas in the middle that are extremely difficult to see and adequately supervise from the sides. Therefore, more guards may be appropriate and/or movable guard stands as necessary.

(4) The maximum number of bathers in the swimming pool at any one time, however, will not exceed one bather for each 25 square feet of water surface of the pool.

(5) Based on conditions, i.e., holidays, patron load, weather, etc., additional guards may be required.

d. Life-Saving Equipment. Sufficient emergency life-saving equipment must be provided at each lifeguard station.

e. First Aid Equipment. Each pool will have the following minimum first aid equipment:

(1) Stretchers.
(2) Blankets.
(3) First aid kit approved by the local medical treatment facility.
(4) Drinking water.
(5) First aid cot.
(6) Pillow.
(7) Telephone with emergency numbers.
(8) Splints.
(9) Back board.

f. Personnel Training. Pool operators and lifeguards will be trained and certified in basic rescue and life-saving techniques (i.e., certification by the American Red Cross or Young Men's/ Women's Christian Association).

g. Pool Regulations. A placard including, but not limited to, the following rules and regulations pertaining to swimmer sanitation and safety must be posted in a prominent location.

(1) All patrons must comply with the directions of lifeguards and/or the pool manager.

(2) Personnel must take a cleansing shower prior to entering the pool.

(3) No persons with sores, skin diseases or bandages will be permitted in the pool.

(4) Spitting, urinating or otherwise contaminating the pool or walkways is prohibited.

Eating, drinking or smoking in the pool or on pool deck is prohibited.

(6) No pets allowed in pool area.
(A guide dog escorting a blind person will be permitted on the pool deck and in restrooms. Also, working dogs accompanied by handlers will be permitted in swimming pool areas as required).

(7) Boisterous or rough play is not permitted in the pool area.

(8) Rafts, air mattresses or flotation devices that could easily become detached from the user are prohibited (Life jackets, water wings or similiar personal safety items may be used by non-swimmers and are permitted in the shallow area only).

(9) Non-swimmers are permitted in shallow area only.

(10) Diving is permitted in designated areas only.

(11) Gymnastics will not be permitted on the diving boards.

(12) Swimming is not permitted in diving areas. Double bouncing is not permitted; only one bounce per dive.

(13) No fraternizing with lifeguards is permitted.

(14) Climbing on lifeguard towers or using lifesaving equipment for other than emergency use is strictly prohibited

4-13. **Sanitation Inspections.**

1. Navy and Marine Corps swimming pool facilities shall be inspected at least monthly by a Medical Department representative in company with the pool manager or designated representative. Special inspections should be performed prior to opening the pool each season, prior to opening a new pool, and prior to opening a pool after renovation. An inspection must be conducted when disease transmission is suspected or upon request of the Recreation Director or the Public Works Officer.

2. Inspections of pools should include chlorine residual and pH testing and a review of bacteriological analysis results. Pool personnel should be trained to perform field tests for chlorine residual (combined and free available chlorine), pH, alkalinity, hardness, clarity, air and water temperature and cyanurates (if applicable). A D.P.D. chlorine test kit must be kept on hand for testing of free available chlorine and pH according to the directions accompanying the kit.

4-14. **Bacteriological Analysis.**

1. All sample bottles, containing two to three drops of 10 percent sodium thiosulfate solution to neutralize chloride, must be sterilized before use. Collect samples in the area of, and during the time of, maximum bather use. Carefully remove the cap of the sterile bottle, and hold the bottle near its base at an angle of 45 degrees. Plunge the bottle vertically into the water about 8 inches (20 cm) to fill, while making sure that the dechlorinating agent is not washed out. Replace the cap without touching the inside of the bottle or cap. Refrigerate the sample at 50°F (10°C) and test within 6 hours of collection. Identifying data, such as sampling time, location of sampling site, sample's identification, and desired analysis, should accompany the sample.

2. Standards. Microbiological testing of swimming pool water can be used to evaluate the disinfection process and to obtain a measure of the potential for pathogen transmission. Samples should be analyzed in accordance with the latest edition of *Standard Methods for the Exxamination of Water and Wastewater*. A satisfactory sample will demonstrate the absence of total coliform bacteria. If a sample is total coliform-positive, three repeat samples will be taken as soon as possible. If two of the three repeat samples are total coliform-negative the pool water is considered bacteriologically satisfactory. For more information concerning microbiological testing using "presence" or "absence" results, refer to Chapter 5 of this manual.

4-15. Records.

Records are necessary for evaluation of pool operation, investigation of complaints, and to justify mechanical improvements; they should be

examined as part of the pool sanitation inspection. The following records should be kept by the pool manager.

1. Total number of swimmers each day. The peak number of swimmers using the pool each day.

2. Length of time the pumps and filters are in operation each day.

3. Time and date each filter is backwashes and cleaned.

4. Amount of chemicals added and time of their addition (e.g., alum, soda ash).

5. Hourly record of chlorinator and chemical solution feeder settings.

6. Inventory of chemicals on hand.

7. Dates of vacuum cleaning.

8. The pH test results, three times daily or as frequently as necessary to assure the pool is within prescribed limits.

9. The total alkalinity and/or calcium hardness each time accomplished.

10. Residual chlorine readings (at least 1 test during each 2 hours of use at varying locations in the pool, one test to be made at the time of the maximum swimming load).

11. Temperature reading as often as necessary to indicate adequate temperature control.

12. Results of bacteriological laboratory analysis of swimming pool water accomplished monthly or more often as required.

Section III. PUBLIC SPAS AND HOT TUBS

4-16. Definition

Spas and hot tubs are also known as whirl pools, jacuzzis, hydro therapy pools or soaking tubs, but will be referred to in this text as "hot tubs." Hot tubs are designed for one or more people to soak in, not bathe. Many brands and types are available for recreational use and require careful operation and maintenance.

4-17. Construction.

Hot tubs must be constructed and installed in accordance with the following Suggested *Health and Safety Guidelines for Public Spas and Hots Tubs,* HHS-99-960, latest edition; local regulations; manufacturer's instructions. All drains and suction openings must have anti-vortex covers or grates with sufficient open area to prevent the flow velocity through the open gates from exceeding 2 feet per second (61 cm per second).

4-18. Water Supply.

The water for use in hot tubs will be obtained from potable or Medical Department approved water sources. To avoid cross-connection, the water supply line must have an air gap or back flow preventer. Overflow water should be returned to the filter system or discharged to an approved waste system. Where overflow is discharged to sewer, an airgap must be provided above possible flood and sewer back up levels.

4-19. Sanitary Facilities.

Sanitary facilities will be provided for use by hot tub patrons. A thorough shower must be taken prior to entering the hot tub to remove common bacteria, lotions, and deodorants. Lotions and deodorants will reduce the effectiveness of the disinfectant and clog the filter.

4-20. Filtration.

The two most commonly used filters in hot tubs are the diatomaceous earth filter and rapid rate sand filter. For filter operation and other filter applications see Article 4-9.8. The circulation equipment must be capable of complete water turnover in 30 minutes. The proper water level must be maintained at all times by filling or draining the hot tub according to manufacturer's instruction.

4-21. Water Quality.

Hot tubs can, and usually do have a higher number of users per water volume than a swimming pool. Additionally, the high temperature and constant motion of the water make it difficult to maintain the proper chemical levels. Some criteria for swimming pool water quality cannot be directly applied to hot tubs.

1. Temperature. The maximum temperature at Navy and Marine Corps hot tub facilities is 104°F (40°C). A temperature at 100°F (38°C) is considered safe and comfortable for a healthy adult. At higher water temperatures, the soaking time should be shorter; limit exposure to 20 minutes at 102°F (39°C) and to 10 minutes at 104°F (40°C). Temperature adjustment should be limited to hot tub operators only.

2. Disinfection. A means of disinfecting the hot tub should be used that provides and maintains an acceptable disinfectant residual in the water. Chlorine is the most frequently used disinfectant in Navy hot tubs. However, bromine systems approved by the Environmental Protection Agency are acceptable alternatives. Other bactericidal agents may be used only with BUMED approval. At least weekly, the hot tub water must be superchlorinated to 10 ppm for 10 hours. The chlorine level must drop to 3 ppm be-

Table 4-5. Water Chemistry Tests for Hot Tubs

Check Hourly During Use	*Range*	*Optimum*
Free Residual Chlorine	1-3 ppm	1.5 ppm
Total Bromine Residual	0.8-3 ppm	1.5 ppm
pH	7.2-7.8	7.5
Check Weekly	*Range*	*Optimum*
Total alkalinity	60-200 ppm	100 ppm

fore use. The following guidelines for hot tub water quality shall be observed:

4-22. **Hot Tub Inspection.**

Hot tubs will be inspected monthly and tested for chemical and bacteriological water quality as stated in Article 4-13.

1. Bacteriological Testing. Bacteriological testing will be done monthly in accordance with Article 4-14.

2. Hot tub management records will be examined as stated in Article 4-15.

3. Turbidity. Water should be clear and not appear cloudy or colored. If water clouds or colors, increase filtration. If unsuccessful, backwash filters and check chlorine and pH levels. If necessary, drain and clean hot tub to restore water clarity.

4-23. **Cleaning.**

Hot tub water must be drained at least monthly. The sides, bottom, decks, and railings should be scrubbed with a 50 ppm chlorine solution. Upon refilling, superchlorinate to 10 ppm, allow level to drop to 3 ppm, and check pH before use. In addition to regular cleaning; a thorough draining and cleaning will be necessary if patrons report any skin rash while using the hot tubs. Decks and railings must be kept clean and algae free by brushing with a 50 ppm chlorine solution as needed.

4-24. **Rules.**

A sign containing the following items must be placed in plain view upon entering hot tub or deck area.

1. Do not use alone.

2. Do not use while under the influence of alcohol, heart medication, antihistamines, or tranquilizers.

3. Elderly persons and those suffering from heart disease, diabetes, and high or low blood pressure should not use the hot tub or spa.

4. Unsupervised children under 10 years old are not allowed in hot tub or immediate area.

5. Do not operate hot tub at water temperatures greater than 104°F (40°C). Observe a reasonable time limit (e.g., 10 minutes), then shower, cool down, and if you wish, return for another brief stay. Long exposure may result in nausea, dizziness or fainting.

6. Always enter and exit slowly.

7. Pregnant women should limit continuous use to less than 10 minutes.

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Hot tubs will be inspected monthly and tested for chemical and bacteriological water quality as stated in Article 4-13.

1. Bacteriological Testing. Bacteriological testing will be done monthly in accordance with Article 4-14.

2. Hot tub management records will be examined as stated in Article 4-15.

3. Turbidity. Water should be clear and not appear cloudy or colored. If water clouds or colors, increase filtration. If unsuccessful, backwash filters and check chlorine and pH levels. If necessary, drain and clean hot tub to restore water clarity.

4-23. **Cleaning.**

Hot tub water must be drained at least monthly. The sides, bottom, decks, and railings should be scrubbed with a 50 ppm chlorine solution. Upon refilling, superchlorinate to 10 ppm, allow level to drop to 3 ppm, and check pH before use. In addition to regular cleaning; a thorough draining and cleaning will be necessary if patrons report any skin rash while using the hot tubs. Decks and railings must be kept clean and algae free by brushing with a 50 ppm chlorine solution as needed.

4-24. **Rules.**

A sign containing the following items must be placed in plain view upon entering hot tub or deck area.

1. Do not use alone.

2. Do not use while under the influence of alcohol, heart medication, antihistamines, or tranquilizers.

3. Elderly persons and those suffering from heart disease, diabetes, and high or low blood pressure should not use the hot tub or spa.

4. Unsupervised children under 10 years old are not allowed in hot tub or immediate area.

5. Do not operate hot tub at water temperatures greater than 104°F (40°C). Observe a reasonable time limit (e.g., 10 minutes), then shower, cool down, and if you wish, return for another brief stay. Long exposure may result in nausea, dizziness or fainting.

6. Always enter and exit slowly.

7. Pregnant women should limit continuous use to less than 10 minutes.

Section IV. NATURAL BATHING PLACES

4-25. Beaches, Fresh and Saltwater.

1. This section applies to any body of water not contained within a structure, but which is under control of the Navy or Marine Corps for swimming, diving, or recreational bathing. This includes seashore, natural lakes, reservoirs and impoundments, ponds, rivers, streams, and asso-

Table 4-6. Natural Bathing Places: Sanitary Facilities Required Based Upon User Load

Facility	Male	Female
Water Closet	1/200	1/150
Lavatories	1/200	1/200
urinals	1/300	0
Showers	1/100	1/100
Drinking Fountains	1/100	1/100

ciated building or equipment.

2. Planning and Review Considerations.

a. A sanitary survey will be conducted by the Medical Department Representative (MDR) of proposed bathing sites to establish the presence or absence of contamination and its source. Consultative survey support should be obtained from a Navy/Marine Corps civil engineer. The survey should include a bacteriological study plus an inspection for such safety hazards as currents, changes in depth, underwater obstructions, visibility, marine life, and temperature. Potential sources of contamination should be identified (e.g., sewer and industrial wastewater outfalls, stormwater outfalls, and contaminated surface water runoff). Consideration should be given to the presence of parasitic, waterborne diseases, such as schistosomiasis or leptospirosis in endemic areas. Provisions for a potable water supply, wastewater disposal, and solid waste disposal must bean integral part of the survey. This information forms the basis of the MDR's recommendation to the Commanding Officer concerning suitability for swimming and such measures of control or improvements as are indicated.

b. Bather load should be anticipated in order to determine the type and amount of sanitary facilities necessary. The bathhouse should be constructed and maintained in accordance with article 4-8.9. Toilet facilities should be located within 500 feet of the beach and provided with plumbing fixtures as recommended in Table 4-6.

c. Playground equipment, if provided, will be in accordance with Articles 242. through 2-44. of this manual.

d. An adequate number of solid waste receptacles with covers will be placed in the beach area and should be emptied at least twice weekly.

e. Prohibitions for Bathing Beaches. Bathing beaches may be prohibited when contamination from sources outlined in Article 4-25.2.a is likely as determined by the MDR or enforcing agency.

Table 4-7. Water Depth Standards for Natural Bathing Place Diving Safety

Platform Type	Water Depth for a Distance of 12 Feet (3.7 m) in all Directions
Platforms 1.6 feet (0.5 meter) above the water surface	9 feet (2.7m)
Platforms 3.3 feet (1 meter) above the water surface	10 feet (3.1 m)
Platforms 9.8 feet (3 meters) above the water surface	12 feet (3.7 m)

f. Design Criteria.

(1) Area Designations. Anchored buoys will be provided where practical to designate the swimming perimeter and to separate deep and shallow water at approximately the 4-foot (1.2 m) depth. The diving area, drop offs, underwater hazards, and wading areas (2 feet (61 cm) and less) should be designated.

(2) Diving Facilities. Diving platforms, floating or fixed, must be constructed with 12 inches (30 cm) of visible airspace above the surface of the water and the bottom of the structure. Underwater construction will be kept to a minimum, however, it should be consistent with maximum swimmer support. All underwater construction will be designed to prevent entrapment of swimmers. No diving platform or diving device will be constructed at heights greater than 9.8 feet (3 meters) above the water surface. Table 4-7 specifies the minimum recommended depth of water in which diving platforms may be located.

(3) A potable water supply under pressure for drinking and sanitary purposes will be provided. If the source is not a public water system, it will be approved and monitored by the cognizant Medical Department (Preventive Medicine Service.)

(4) Sanitary and Bacteriological Survey. A sanitary survey of an existing beach and surrounding area and a bacteriological survey of the water must be done prior to opening the beach at the beginning of the season and should be done

periodically during the season.

(a) Sanitary Survey. The sanitary survey of existing beaches is similar to the survey of proposed bathing sites. Toilet facilities and bathhouses should also be inspected for sanitary condition.

b) Bacteriological Survey. The fecal coliform: fecal streptococcus ratio can be used as an indicator mechanism for evaluating the microbiological suitability of natural bodies of water. Ratios of 4.0 or higher typically indicate domestic sewage contamination while ratios of 0.6 or lower are common to discharges from farm animals or stormwater runoff. Refer to *Standard Methods for the Examination of Water and Wastewater* on the use of this ratio. For proper water collection technique refer to Article 4-14.

(5) Safety Requirements.

(a) Beaches, whether they be on lakes, rivers or oceans, have their own particular safety hazards. These hazards are influence by environmental factors, i.e., weather, currents, waves, water clarity, weeds and winds. These added safety hazards place even greater responsibility on the beach guards to ensure the safety of each swimmer. Therefore, guards should receive specialized training to deal with their particular guard assignments, to include an understanding of when the ratio of lifeguards to swimmers at designated beach areas must be modified. The below listed minimum requirements for staffing designated beach areas are to be followed

1 At least one guard must be stationed for every 200 linear feet of designated beach front and should be posted at a tower. An additional guard will be available for duty that can serve as a back-up within 2 minutes from the time a guard leaves the station for emergency action. A proven communication system, i.e., radio with separate frequency, telephone, whistle, etc., is essential. Lifeguard stations may be farther apart than 200 feet, but not to exceed 200 yards, where less crowded conditions prevail or heavy surf conditions preclude extensive bathing.

2 Based on conditions, i.e., holidays, patron load, weather, etc., additional guards may be required.

(b) Sufficient emergency life-saving equipment must be provided at each lifeguard station.

(c) Each beach location will have signs posted at appropriate intervals listing beach regulations. Suggested regulations:

1 No swimming when lifeguard not on duty.

2 No swimming after dark.

3 No roughhousing or sand throwing.

4 No glass bottles or containers on beach.

5 No pets (A guide dog escorting a blind person will be permitted on the beach and in restrooms. Also, working dogs accompanied by handlers will be permitted on beach area as required).

6 Swimming designated areas only.

7 No littering.

8 No scuba gear in swimming area.

9 No boats, canoes, or surfboards in swimming area.

10 No fishing in or near swimming area.

(d) Normally beaches are operated by an aquatic supervisor, beach manager, or person responsible to the Recreation Director. The beach operator or another responsible person should make a check of the facility beach, water, and equipment prior to opening each day.

(e) Records will be maintained which include, but are not limited to: name of the beach, names of persons on duty, general weather conditions, number of bathers, and water analysis reports.

4-26. Over-the-side Swimming.

OPNAVINST 3120.32 authorizes Commanding Officers to permit the over-the-side swimming. Depending on conditions, location and class of ship, the "swim call" may be over the side, swimming in flooded well decks, or swimming from beaches. Medical Department personnel must be prepared to submit practical recommendations to Commanding Officers concerning health hazards and safety precautions for these evolutions.

1. Swimming over-the-side (in the immediate area of the ship) is prohibited when the ship is in water suspected or known to be contaminated. Unless approved by the Senior Officer Present Afloat (SOPA), swimming over-the-side is prohibited in harbors or other fleet concentrations.

2. Any available medical intelligence concerning dangerous marine life, parasites, and waterborne diseases prevalent in the ship's geographical area should be considered prior to permitting swimming.

3. The water should be clear and free of float-

ing or submerged debris, oil, algae and dangerous marine life.

4. All suction and discharge outlets should be secured 30 minutes before swimming.

5. When the ship is anchored, a swimming area should be designated preferably with anchored buoys on the leeward side of the ship.

6. Adequate resting devices (e.g., lowered accommodation ladder, rope ladder, "Jacob's ladder," secured inflated rafts) must be provided to accommodate the swimmers.

7. Two swimmers, qualified as lifeguards, must be posted for each group of swimmers less than 100 persons with one additional lifeguard for each additional 50 swimmers or fraction thereof.

8. One boat provided for "man overboard" must be in the water adjacent to the swimming area. An additional boat will be provided for parties larger than 100.

9. Two persons qualified in the use of small arms and provided with weapons and binoculars should be posted as shark guards in the ship's superstructure or other location with a clear view of the designated swimming area and adjacent waters.

10. A loudspeaker, megaphone or the ship's 1 MC system should be available to the officer-in-charge of the swimming party in order to recall and direct swimmers. Additionally, he should have communication with the small boats, shark guards, and the bridge.

11. Swim call should begin at least one hour after the last meal and be authorized only during daylight hours. The weather forecast should be for clear and calm weather. Personnel on the bridge should be alert for squalls or thunderstorms and should recall swimmers, as necessary.

4-27. **Flooded Well Deck Swimming.**

1. Swimming in an enclosed well deck is preferred to over-the-side swimming, if practical.

2. Wash down bulkhead and deck with water and scrub soiled and greasy areas.

3. Two swimmers qualified as lifeguards will be posted for each group of less than 100 swimmers, plus one for each additional 50 swimmers.

4. A complete exchange of water must be provided each eight hours during periods of continuous use.

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4. All suction and discharge outlets should be secured 30 minutes before swimming.

5. When the ship is anchored, a swimming area should be designated preferably with anchored buoys on the leeward side of the ship.

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Section V. REFERENCES

4-28. References. The following references contain useful information and were used to prepare this chapter. Medical Departments should procure the publication as applicable to individual aquatic facilities. Sanitary requirements and technical data may vary considerably between references; therefore, Medical Department personnel must use this chapter as the standard reference for Navy and Marine Corps swimming evolutions and aquatic facility sanitation.

1. Military Publications

a. AF regulation 161-14, Swimming Pools and Bathing Areas.

b. Bureau of Naval Personnel, Aquatic Operator Handbook.

c. Department of Defense Construction Criteria Manual, DOD 4270.1-M.

d. NAVFAC DM-37.1, Swimming Pools.

e. NAVMED P-5052-6A, Technical Information Manual for Medical Corps Officers, 1962.

f. NAVMILPERSCOMINST 1710.6, Recreational Water Safety Program.

g. OPNAVINST 3120.32 series, Standard Organization and Regulations of the U.S. Navy.

2. Civilian Publications

a. American Public Health Association, *Control of Communicable Disease in Man,* 15th cd., Washington, D. C., 1990.

b. American Public Health Association, American Water Works Association, Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater,* 17th ed., Washington, D. C., 1981.

c. American Public Health Association, ***Public Swimming Pools, New*** York, 1981.

d. Committee of the Great Lakes, Upper Mississippi River Board of State Sanitary Engineers, *Recommended Standards for Bathing Beaches,* Health Education Service, Albany, New York, 1975.

e. Council for National Cooperation in Aquatics, *Swimming Pools, Guide to their Planning, design, and Operation,* 3rd ed., Fort Lauderdale Hoffman Publication, Inc., 1975.

f. Seattle-King County Department of Public Health, *Staying Happy and Healthy in your Spa and Hot Tub,* Environmental Health Division, Seattle-King County Department of Public Health, Washington, 1981.

g. Thomas, D.G., Swimming *Pool Operators Handbook,* National Swimming Pool Foundation, Washington, D. C., 1972.

h. U.S. Department of Health and Human Services, Suggested *Health and Safety Guidelines for Public Spas and Hot Tubs,* HHS-99-960, Centers for Disease Control, Public Health Service, Atlanta, 1985.

i. U.S. Department of Health, Education and Welfare, *Swimming Pools, Safety and Disease Control Through Proper Design and Operation,* Publication No. (CDC) 77-8319, Centers for Disease Control, Public Health Service, Atlanta, 1976.

j. U.S. Environmental Protection Agency, Cross *Connection Control Manual,* EPA Water Supply Division, Washington D. C., 1989.